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(71) Applicant (*for all designated States except US*): PHASE ONE DENMARK A/S [DK/DK]; Roskildevej 39, DK-2000 Frederiksberg (DK).

(72) Inventors; and
(75) Inventors/Applicants (*for US only*): KNUDSEN, Niels, V. [DK/DK]; Phistersvej 4, st., DK-2900 Hellerup (DK). JØNSSON, Michael [DK/DK]; Mejsebo 32, DK-2665 Vallensbæk (DK).

(74) Agent: PLOUGMANN, VINGTOFT & PARTNERS A/S; Sankt Annæ Plads 11, P.O. Box 3007, DK-1021 Copenhagen K (DK).

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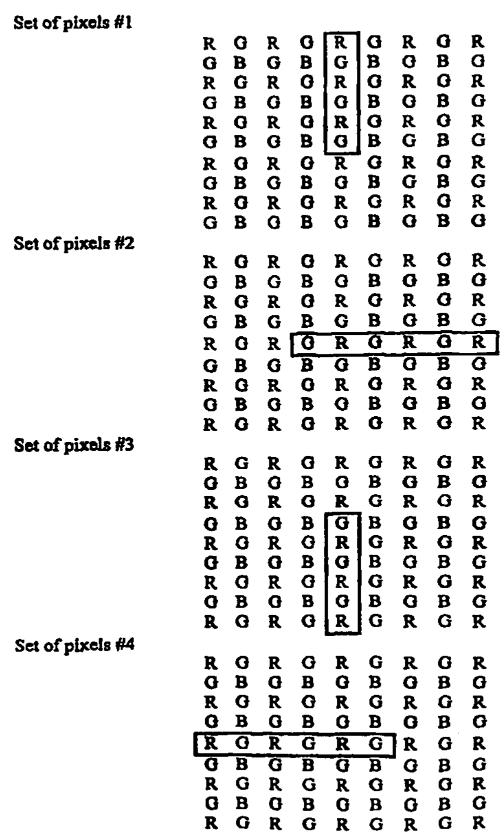
(54) Title: A METHOD AND A SYSTEM FOR PROCESSING IMAGES

(57) Abstract

The present invention relates to a method and a system for processing images. The invention relates in particular to a method and a system for processing an image using interpolating. The method determines a variation value for different sets of pixels in a CCD, and the set of pixels with the highest correlation (lowest numeric value) is selected. A missing colour at a given pixel is expressed in terms of the information contained in the selected set of pixels. If the variation value is below a certain threshold, due to noise or other factors, an alternative set of pixels using a different variation method may be selected. The missing colour is estimated as a weighted sum of e.g. the green samples divided by the weighted sum of e.g. the red samples multiplied by the sampled value from the pixel to be estimated.



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A METHOD AND A SYSTEM FOR PROCESSING IMAGES

This invention relates to a method and a system for processing images. The invention relates in particular to a method and a system for processing an image using interpolating.

It is well known to represent an image digitally by dividing the image into a large number of segments, denoted pixels, and allocating digital values, denoted pixel values, to each pixel. Typically, the image is divided into a matrix of rows and columns of pixels and the size of a digital image is then given by the number of pixels in a row and the number of pixels in a column. The pixel values are typically stored in an array in a digital memory.

For example, a grey tone image may be represented digitally by a digital image comprising pixels each of which has one pixel value representing the grey tone of the corresponding pixel. Similarly, a colour image may be represented by a digital image comprising pixels each of which have three pixel values, one for each of the colours red, green, and blue.

Typically, a digital image is created by transmission of light towards an object and detection by an electronic camera of light reflected from or transmitted through the object. However, in general a digital image may be created by transmission of any kind of radiated energy, such as electromagnetic radiation, such as visible light, infrared radiation, ultraviolet radiation, X-rays, radio waves, etc, ultrasound energy, particle energy, such as electrons, neutrons, etc, etc, towards an object for interaction with the object and by detection of energy having interacted with the object, such as by reflection, refraction, absorption, etc.

A digital image may be formed by any imaging system, such as radiometer systems, infrared systems, radar systems, ultrasound systems, X-ray systems, electronic cameras, digital scanners, etc, adapted to detect the kind of energy in question and to generate a digital image based on the energy detection.

The amount of energy needed to record a digital image with a desired signal to noise ratio, i.e. the sensitivity of the imaging system, is determined by the noise level in the imaging system. Energy detectors of any kind generate noise that adds to the signal desired to be recorded. The signal to noise level of a digital image is typically required to

be comparable to if not better than the signal to noise level of an image recorded on a photographic film for subsequent reproduction in professional publications.

Typically, an image recording system operating in the visible light range of electromagnetic radiation, such as an electronic camera, a digital camera, an electronic scanner, a digital scanner, etc, uses a solid state imaging device, typically a charge coupled device (CCD), for recording of an image.

The CCD is an array of a large number of light sensitive detectors connected to each other as an analog shift register. In each detector of the CCD a charge is formed that is proportional to the light energy incident on the detector during an integration period. The analog charge of each detector is shifted serially out of the CCD and is typically converted to a digital value whereby a digital representation of the recorded image is formed. Each pixel value of the digital image is equal to the digitised charge of the corresponding CCD detector. The pixel values may be transferred to an external computer through a computer interface or may be stored on a memory card or on a rotating magnetic recording medium.

It is known in the art to use linear CCDs in an image recording system in which the linear CCDs light-sensing detectors are arranged in a single line. Typically, the array is moved across the image, scanning it one line at a time. For colour images, filters can be placed in front of the array, which then makes three passes across the image during image recording.

Offering a good compromise of image resolution (high pixel count) and cost in an image recording system is the trilinear CCD array, which comprises three linear CCDs positioned side by side. Each line is covered by its own colour filter. The array makes a single pass across the image, and each linear CCD records a line at a time.

At a higher cost, a two-dimensional CCD array can capture the entire image in a very short time. Three separate exposures with three colour filters can be used to make a colour representation. For example, the colour filters can be placed in a rotating wheel that sequentially inserts each colour filter in the optical path between the image forming optics of the image recording system and the two-dimensional CCD array.

In the present context, the term exposure is to be understood in a broad sense as the time period during which an energy sensor is actually sensing the energy. For example, a photographic film is exposed to light whenever light is incident upon it, while a CCD is exposed to light when the elements of the CCD are allowed to integrate light incident upon them. The CCD is not exposed when its light sensing elements are short-circuited although light may be incident upon them.

It is well known in the art to size a digital image, i.e. to change, typically reduce or enlarge, the size of the digital image, i.e. the number of pixels of the digital image in order to minimise the amount of pixel data to be stored for later processing of the digital image. Various, sometimes complex, strategies for forming sets of pixels from which new pixel values are calculated may be employed. In a very simple example, a digital image may be downsized by reducing the number of pixels of the digital image by an integer, e.g. by a number of four. In this case, the pixels of the original digital image is divided into sets of four pixels each and each set of pixels is transformed into a new pixel of a pixel value equal to the average value of the original pixel values. Thereby, a new digital image of one-fourth the size of the original digital image is generated.

Further, it is well-known to adjust brightness of an image produced from a digital image by forming a new digital image with the same number of pixels as the original image in which each of the new pixel values is generated by a linear or non-linear transformation of the corresponding original pixel value.

Further it is well known from e.g. US 5,373,322 that in order to generate a high quality colour information relating to at least three primary colours are required at the position of each pixel in an image. In case where information's relating to three primary colours are not available in each pixel of e.g. a CCD interpolation complex methods involving linear or non-linear transformation methods are required.

A disadvantage of these complex conventional processing methods is related to the time required for processing the image. To obtain a high quality colour image complicated mathematical algorithms are applied in the process of transforming a low-resolution colour image into a high-resolution colour image.

A further disadvantage of the conventional processing methods is related to the presence of colour artefact (aliasing) which significantly disturbs the interpretation of a colour image.

It is an object of the present invention to provide a method and a system for estimating the missing colours in images recorded using colour filter array based CCD technology.

It is another object of the present invention to provide a method and a system for estimating the missing colours in images recorded using scanner-based technology.

It is a still another object of the present invention to provide an image processing method comprising the steps of

(a) dividing an image into a matrix of pixels for holding colour values, and

(b) interpolating a colour (A) value of a selected pixel by calculating the colour (A) value from colour values of a selected set of pixels that are positioned adjacent to the selected pixel, the influence of at least one pixel abutting the selected pixel being significantly reduced whereby blurring of distinct features of the image is substantially avoided.

By adjacent is meant that the selected set of pixels should be near the selected pixel. The term significantly reduced should be understood as lowly weighted or excluded from the selected set of pixels.

The image processing method further comprising the steps of

(a) forming a first set of pixels that are positioned adjacent to the selected pixel, and calculating a first variation value of colour values of the pixels of the first set,

(b) forming a second set of pixels that are positioned adjacent to the selected pixel, and calculating a second variation value of colour values of the pixels of the second set,

(c) comparing the first and second variation values, and calculating the colour (A) value from colour values of the set of pixels with the lowest variation value.

The image processing method further includes a step, wherein colour (B) values of the set of pixels with the lowest variation value are included in the calculation of the colour (A) value. In particular the colour (B) values are included in the calculation of variation values of the first and second set of pixels, respectively.

According to the present invention each of the steps of calculating variation values of the first and second set of pixels, respectively, comprises

(a) calculating the ratio between colour (A) values and colour (B) values of abutting pixels of the respective set of pixels,

(b) calculating a mean value of the calculated ratio values, and

(c) calculating the variation value of the respective set of pixels as the sum of the absolute value of the difference between each of the ratios and the mean value.

The step of calculating the colour (A) value comprises

(a) calculating a weighted sum of colour (B) values of the set of pixels with the lowest variation value,

(b) calculating a weighted sum of colour (A) values of the set of pixels with the lowest variation value, and

(c) calculating the colour (A) value by multiplying the colour (B) value of the selected pixel with the ratio between the weighted sums of colour (A) and colour (B) values.

The colour (A) value may be calculated from not only two colour values. The colour (A) value may be calculated from an arbitrary number of colour values.

The image recorded for further processing may be recorded by an electronic camera comprising a scanner or a CCD or a Bulk Charge Modulated Device (BCMD).

In case of an electronic camera comprising a CCD the camera may further comprise a colour filter mask positioned in front of the CCD, said colour filter mask comprising a plurality of colour filters. The colour filter mask may be of the type Bayer 2G.

The selected set of pixels may take any form and may comprise an arbitrary number of pixels.

In particular, the selected sets of pixels may be arranged in rows and columns parallel to the rows and columns of the pixels in the image matrix. Alternatively the selected sets of pixels may be arranged in rows at an angle of approximately 45 degree relative to the rows and columns of pixels in the image.

In another alternative the selected sets of pixels may be arranged in rows and columns parallel to the rows and columns of the pixels in the image matrix and at an angle of approximately 45 degree relative to the rows and columns of pixels in the image.

The selected set of pixels may also be arranged at an arbitrary angle relative to the rows and columns of the pixels in the image.

The number of selected sets of pixels may be arbitrary. Preferably the number of selected sets of pixels is larger than 2, such as 4.

It is a still another object of the invention to provide an image processing system comprising

(a) a memory for storage of colour values of a matrix of pixels of an image, and

(b) a processor that is connected to the memory and that is adapted for interpolating a colour (A) value of a selected pixel by calculating the colour (A) value from colour values of a selected set of pixels that are positioned adjacent to the selected pixel, the influence of at least one pixel abutting the selected pixel being significantly reduced whereby blurring of distinct features of the image is substantially avoided.

According to the invention the image processing system may further comprise an electronic camera comprising a scanner and CCD.

It is an advantage of the present invention is that the method and system significantly improves the ability to estimate the missing luminance information in a digitised image. A correct estimation of the missing luminance information is vital for the impression of sharpness and detail richness.

It is further advantage of the present invention is that all chrominance information are preserved to give images the highest degree of colour fidelity while avoiding all of the well known aliasing.

It is a still further advantage of the present invention is the relative low complexity of the method that makes it easy to implement in both software and/or hardware based applications. The method is also applicable in other areas of imaging such as image scaling, image compression and visual enhancements such as unsharp masking and noise reduction.

In the following the invention will be described with reference to the accompanying figures.

Fig. 1 shows a colour filter pattern of the type Bayer 2G. Each cell in the grid represents a photosite or pixel on the m x n array CCD where m is the number of photosites in each row on the CCD, n is the number of rows on the CCD, R is the number of photosites covered with red filter material (called Red photosites), G is the number of photosites covered with green filter material (called Green photosites) and B is the number of photosites covered with blue filter material (called Blue photosites)

Fig. 2 shows an illustration of four selected set of pixels.

Fig. 3 shows a reference image recorded using a state-of-art digital camera with three CCD arrays.

Fig. 4 shows an image recorded using a digital camera with only one CCD array and processed according to the present invention.

Fig. 5 shows an image recorded using a digital camera with only one CCD array and processed according to convention methods.

To construct a m x n RGB image the Green and Blue values have to be estimated at photosites covered with Red filter material and the Blue and Red values at photosites covered with Green filter material and finally the Red and Green values at photosites covered with Blue filter material.

Note that the Bayer pattern has twice the amount of photosites covered with Green filter material than those with Blue and Red filter material, hence the name Bayer 2G.

The part of the visual wavelengths sampled by the Green photosites represents most of the pure luminance information. The Blue and Red photosites carries most of the crominance information, but the fact that the Blue and Red photosites also carries a lot of pure luminance information is crucial for the interpolation method of the present invention. In the present invention the missing Green information at photosites covered with Red filter material is solely based on the variation between values from a selected set of Green and Red photosites taken from the surrounding area. The set of values from photosites must be segmented in such a way that it is possible to distinguish between edge boundaries.

Selection of sets of pixels to be considered for possible interpolation depends mostly on the actual layout of the colour filter array in question. The number and the choice of set of pixels have profound impact on the performance of the method.

In the case of the Bayer 2G pattern a set of pixels for estimating the Green samples at Red photosites could be as shown in Fig. 2.

The same principle can be applied when selecting the set of pixels for estimating the Green samples at Blue photosites. Again, the set of photosites that are chosen for each set of pixels is critical for the correctness of the estimation.

Referring to Fig. 2, the 4 sets of pixels appears to be sufficient for detection of very fine details still without introducing too much noise and other artefacts in low detail areas of the image.

A variation value, corr, is calculated for each set of pixels. The variation function expresses to which extend the information reduced from one colour at a given site can be

used to estimate the influence of the same colour at a different site, i.e. to reduce the influence of the Green colour at e.g. the photosite of a Red filter.

Due to performance constrains the variation formula must be kept as simple as possible still without sacrificing the quality of the output. The formula can be expressed using classic linear correlation.

The formula used in a preferred embodiment of the present invention is given by:

$$\mathrm{mean} := \sum_{n=1}^{m} \frac{G_n}{R_n} \cdot \frac{1}{m}$$

$$\mathrm{corr} := \sum_{n=1}^{m} \left| \frac{G_n}{R_n} - \mathrm{mean} \right|$$

Where G is the green pixels in the set of pixels, R is the red pixels in the set of pixels, m is the number of pixels in each set of pixels, mean is the average ratio between red and green pixels and corr is the variations between red and green pixels. Lower values represent higher correlation.

When a variation value has been calculated for every set of pixels, the set of pixels with the highest correlation (lowest numeric value) is selected. This variation value will be used in the further estimation process.

The missing colour at a given photosite is expressed in terms of the information contained in the selected set of pixels. If the variation is below a certain threshold, due to noise or other factors, an alternative set of pixels using a different variation method may be selected.

The missing colour is estimated as a weighted sum of the green samples divided by the weighted sum of the red samples multiplied by the sampled value from the photosite to be estimated. This may be expressed in the following way:

$$Rw := \sum_{n=1}^{m} R_n \cdot w_n$$

$$Gw := \sum_{n=1}^{m} G_n \cdot w_n$$

$$Ge := R_k \cdot \frac{Gw}{Rw}$$

where Rw is the weighted sum of Red samples in the set of pixels, Gw is the weighted sum of Green samples in the set of pixels, Rk is the sampled value from the photosite in question and Ge is the estimated Green value.

In order to process the full image the above-mentioned process is repeated for each pixel in the image until all the missing colours have been estimated.

CLAIMS

1. An image processing method comprising the steps of

- dividing an image into a matrix of pixels for holding colour values, and

- interpolating a colour (A) value of a selected pixel by calculating the colour (A) value from colour values of a selected set of pixels that are positioned adjacent to the selected pixel, the influence of at least one pixel abutting the selected pixel being significantly reduced whereby blurring of distinct features of the image is substantially avoided.

2. A method according to claim 1, further comprising the steps of

- forming a first set of pixels that are positioned adjacent to the selected pixel,

- calculating a first variation value of colour values of the pixels of the first set,

- forming a second set of pixels that are positioned adjacent to the selected pixel,

- calculating a second variation value of colour values of the pixels of the second set,

- comparing the first and second variation values, and

- calculating the colour (A) value from colour values of the set of pixels with the lowest variation value.

3. A method according to claim 2, wherein colour (B) values of the set of pixels with the lowest variation value are included in the calculation of the colour (A) value.

4. A method according to claim 2 or 3, wherein colour (B) values are included in the calculation of variation values of the first and second set of pixels, respectively.

5. A method according to claim 4, wherein each of the steps of calculating variation values of the first and second set of pixels, respectively, comprises

- calculating the ratio between colour (A) values and colour (B) values of abutting pixels of the respective set of pixels,

- calculating a mean value of the calculated ratio values, and

- calculating the variation value of the respective set of pixels as the sum of the absolute value of the difference between each of the ratios and the mean value.

6. A method according to any of the preceding claims, wherein the step of calculating the colour (A) value comprises

- calculating a weighted sum of colour (B) values of the set of pixels with the lowest variation value,

- calculating a weighted sum of colour (A) values of the set of pixels with the lowest variation value, and

- calculating the colour (A) by multiplying the colour (B) value of the selected pixel with the ratio between the weighted sums of colour (A) and colour (B) values.

7. A method according to claim 1, wherein the colour (A) value is calculated from an arbitrary number of colours.

8. A method according to claim 1, wherein the number of selected sets of pixels is arbitrary.

9. A method according to claim 1, wherein the image is recorded by an electronic camera.

10. A method according to claim 9, wherein the electronic camera comprises a scanner.

11. A method according to claim 9, wherein the electronic camera comprises a C-MOS imager.

12. A system according to claim 9, wherein the electronic camera comprises a BCMD.

13. A method according to claim 9, wherein the electronic camera comprises a CCD.

14. A method according to claim 13, wherein the electronic camera further comprises a colour filter mask positioned in front of the CCD, said colour filter mask comprising a plurality of colour filters.

15. A method according to claim 14, wherein the colour filter mask is of the type Bayer 2G.

16. A method according to claim 1, wherein the selected sets of pixels are arranged in rows and columns parallel to the rows and columns of the pixels in the image.

17. A method according to claim 1, wherein the selected sets of pixels are arranged in rows at an angle of approximately 45 degree relative to the rows and columns of the pixels in the image.

18. A method according to claim 1, wherein the selected sets of pixels are arranged in rows at an angle of approximately 45 degree relative to the rows and columns of the pixels in the image and in rows and columns parallel to the rows and columns of the pixels in the image.

19. A method according to claim 1, wherein the selected sets of pixels are arranged in rows at an arbitrary angle relative to the rows and columns of the pixels in the image.

20. A method according to claim 1, wherein the selected set of pixels may take any form.

21. A method according to any of the claims 16 - 20, wherein the number of selected set of pixels is 4.

22. An image processing method comprising the steps of

- dividing an image into a matrix of pixels for holding colour values, and

- interpolating a colour (A) value of a selected pixel by calculating the colour (A) value from colour values of a selected set of pixels that are positioned adjacent to the selected pixel, the influence of at least one pixel abutting the selected pixel being significantly reduced whereby blurring of distinct features of the image is substantially avoided.

23. A method according to claim 22, further comprising the steps of

- forming at least two set of pixels each of these sets being positioned adjacent to the selected pixel,

- calculating a variation value of colour values of the pixels of each set,

- comparing each of the calculated variation values, and

- calculating the colour (A) value from colour values of the set of pixels with the lowest variation value.

24. A method according to claim 23, wherein colour (B) values of the set of pixels with the lowest variation value are included in the calculation of the colour (A) value.

25. A method according to claim 23 or 24, wherein colour (B) values are included in the calculation of variation values of each set of pixels.26. A method according to claim 25, wherein each of the steps of calculating variation values of each set of pixels, comprises

- calculating the ratio between colour (A) values and colour (B) values of abutting pixels of the respective set of pixels,

- calculating a mean value of the calculated ratio values, and

- calculating the variation value of the respective set of pixels as the sum of the absolute value of the difference between each of the ratios and the mean value.

27. A method according to any of the claims 22 - 26, wherein the step of calculating the colour (A) value comprises

- calculating a weighted sum of colour (B) values of the set of pixels with the lowest variation value,

- calculating a weighted sum of colour (A) values of the set of pixels with the lowest variation value, and

- calculating the colour (A) by multiplying the colour (B) value of the selected pixel with the ratio between the weighted sums of colour (A) and colour (B) values.

28. A method according to claim 22, wherein the colour (A) value is calculated from an arbitrary number of colours.

29. A method according to claim 22, wherein the number of selected sets of pixels is arbitrary.

30. A method according to claim 22, wherein the image is recorded by an electronic camera.

31. A method according to claim 30, wherein the electronic camera comprises a scanner.

32. A method according to claim 30, wherein the electronic camera comprises a C-MOS imager.

33. A method according to claim 30, wherein the electronic camera comprises a CCD.

34. A method according to claim 30, wherein the electronic camera comprises a BCMD.

35. A method according to claim 33, wherein the electronic camera further comprises a colour filter mask positioned in front of the CCD, said colour filter mask comprising a plurality of colour filters.

36. A method according to claim 35, wherein the colour filter mask is of the type Bayer 2G.

37. A method according to claim 22, wherein the selected sets of pixels are arranged in rows and columns parallel to the rows and columns of the pixels in the image.

38. A method according to claim 22, wherein the selected sets of pixels are arranged in rows at an angle of approximately 45 degree relative to the rows and columns of the pixels in the image.

39. A method according to claim 22, wherein the selected sets of pixels are arranged in rows at an angle of approximately 45 degree relative to the rows and columns of the pixels in the image and in rows and columns parallel to the rows and columns of the pixels in the image.

40. A method according to claim 22, wherein the selected sets of pixels are arranged in rows at an arbitrary angle relative to the rows and columns of the pixels in the image.

41. A method according to claim 22, wherein the selected set of pixels may take any form.

42. A method according to any of the claims 37 - 41, wherein the number of selected sets of pixels is larger than 2, such as 4.

43. An image processing system comprising

- a memory for storage of colour values of a matrix of pixels of an image, and

- a processor that is connected to the memory and that is adapted for interpolating a colour (A) value of a selected pixel by calculating the colour (A) value from colour values of a selected set of pixels that are positioned adjacent to the selected pixel,

the influence of at least one pixel abutting the selected pixel being significantly reduced whereby blurring of distinct features of the image is substantially avoided.

44. A system according to claim 43, comprising an electronic camera.

45. A system according to claim 44, wherein the electronic camera comprises a scanner.

46. A system according to claim 44, wherein the electronic camera comprises a C-MOS imager.

47. A system according to claim 44, wherein the electronic camera comprises a CCD.

48. A system according to claim 44, wherein the electronic camera comprises a BCMD.

#	1	2	3	4	5	6	..	m
1	**R**	**G**	R	G	R	G	R	G
2	**G**	**B**	G	B	G	B	G	B
3	R	G	R	G	R	G	R	G
4	G	B	G	B	G	B	G	B
5	R	G	R	G	R	G	R	G
6	G	B	G	B	G	B	G	B
..	R	G	R	G	R	G	R	G
n	G	B	G	B	G	B	G	B

Fig. 1

Set of pixels #1

R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G

Set of pixels #2

R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R

Set of pixels #3

R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R

Set of pixels #4

R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R
G	B	G	B	G	B	G	B	G
R	G	R	G	R	G	R	G	R

Fig. 2

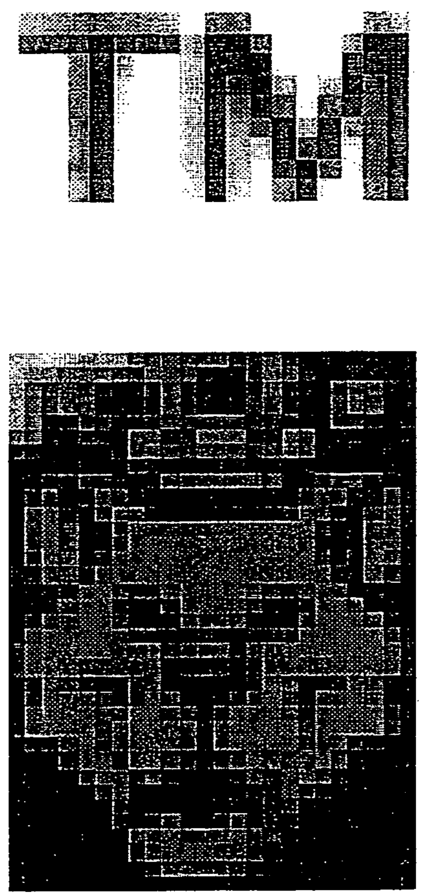

Fig. 3

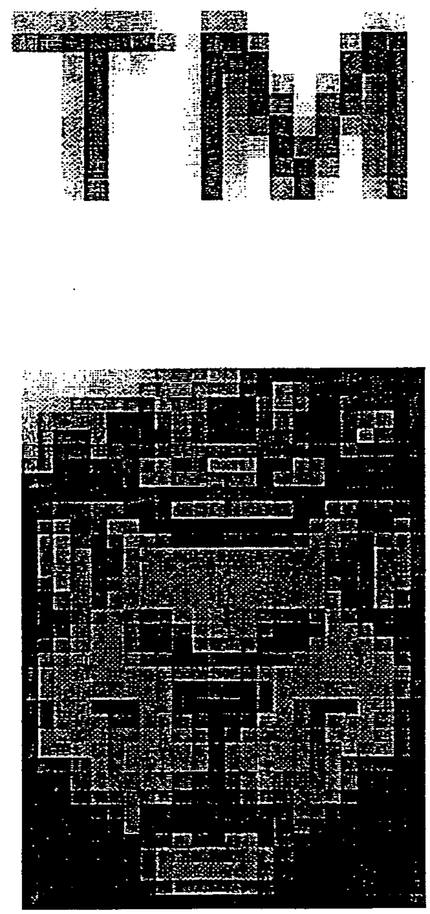

Fig. 4

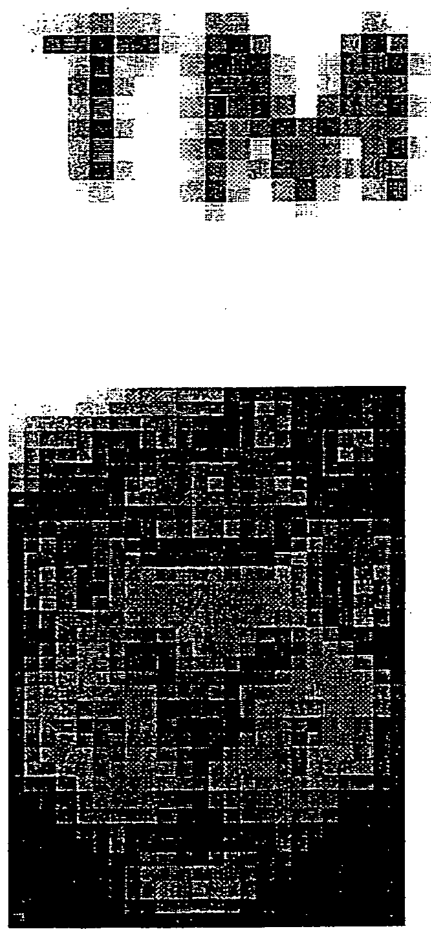

Fig. 5

INTERNATIONAL SEARCH REPORT

International Application No
PCT/DK 99/00393

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06T3/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06T H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 48231 A (ITERATED SYSTEMS INC) 18 December 1997 (1997-12-18) abstract; claim 1 page 5, paragraph 5	1-48
X	US 5 652 621 A (ADAMS JR JAMES E ET AL) 29 July 1997 (1997-07-29) abstract; claims 1,2 column 2, line 47 - line 66	1-48
A	EP 0 632 663 A (EASTMAN KODAK CO) 4 January 1995 (1995-01-04)	
A	WO 97 35438 A (VLSI VISION LTD ;DENYER PETER BRIAN (GB); SMITH STEWART GRESTY (GB) 25 September 1997 (1997-09-25)	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 October 1999	11/10/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Pierfederici, A

INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern   ıal Application No
PCT/DK 99/00393

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